PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : B29C 45/30 — A1

(11) International Publication Number: WO 97/43105

(43) International Publication Date: 20 November 1997 (20.11.97)

(21) International Application Number: PCT/SE97/00731

(22) International Filing Date: 13 May 1997 (13.05.97)

(30) Priority Data:
9601803-1 13 May 1996 (13.05.96) SE

(71) Applicant *(for all designated States except US)*: FLEXIJECT INNOVATION HB [SE/SE]; Värmlandsgatan 2, S-441 57 Alingsås (SE).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: KARLSSON, Lennart [SE/SE]; Värmlandsgatan 2, S-441 57 Alingsås (SE).

(74) Agent: GÖTEBORGS PATENTBYRÅ AB; P.O. Box 5005, S-402 21 Göteborg (SE).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published

With international search report.

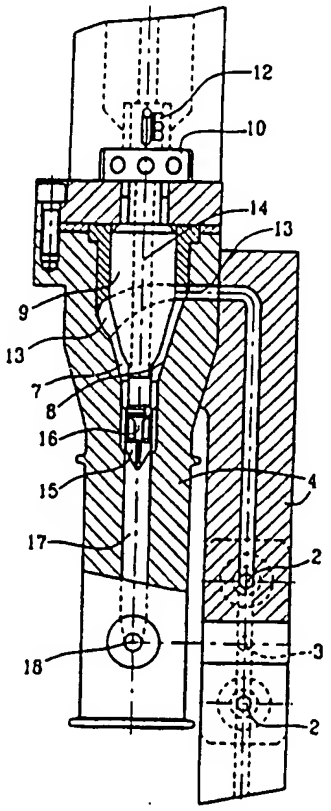
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

In English translation (filed in Swedish).

(54) Title: METHOD AND SYSTEM FOR INJECTION MOULDING OF THERMOPLASTS AND THERMOELASTOMERS

(57) Abstract

System and method for injection moulding of thermoplastics and thermoplastic elastomers in an injection moulding machine for injection moulding details of different weight, size and shape simultaneously in only one process cycle, and incorporating a feeder block (1), a number of hot moulding modules (4, 5), each connected to its own one of a number of flow channels (2) provided in the feeder block, a torpedo (9) provided in the flow channel for each hot moulding module and intended for stepless adjustment of the melt flow through the module, and means for causing final filling, compression and change-over to and maintaining of post pressure, and a control unit for individual control and supervision of the processes in the different hot moulding modules, whereby the flow channel of the hot moulding module is provided with a movable bar (14) extending axially therethrough, and which at its forward end is designed as a ram (15, 16), which is adapted to operate in a melt channel space (17) downstream of the torpedo (9) for causing final filling, compression, change-over to post pressure and maintaining this, and which bar is connected to an individual driving device arranged to give the bar axial motion and pressure force under control from the control unit.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Hosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

METHOD AND SYSTEM FOR INJECTION MOULDING OF THERMOPLASTS AND THERMOELASTOMERS

The present invention refers to a system and a method for injection moulding of thermoplastics and thermoplastic elastomers in an injection moulding machine.

At injection moulding of plastic details is used a die having one or more cavities, which is set up in an injection moulding machine.

In order to be able to produce plastic details of high quality from a die having several cavities, a so called multiple cavity die, the cavities with the associated sprues must be substantially identical with respect to flow resistance for the plastics melt during the filling procedure, and furthermore the volumes of the cavities must be equally big, whereby all cavities are filled up with the melt at the same time, whereupon the melt at the same time also is subjected to compression and post pressure. This means that the plastic details must be alike with reference to material thickness, size and weight and they must have substantially the same shape.

At injection moulding in a single cavity with a process cycle time of e.g. about 30 seconds, the annual manufacturing capacity will be about 500.000 pieces. If the annual demand is at this level or lower, it thus is sufficient to produce using a 1-cavity die in a machine, which is chosen so that mould clamping force, platen size, shot weight, etcetera, are sufficient for the die. The process cost per piece at injection moulding in a 1-cavity die however will be higher as compared to injection moulding in multiple cavity dies. At production of medium-seized annual numbers, about 100 - 500.000 details, it therefore usually is profitable to produce in multiple cavity dies, even if these have a higher initial cost than a 1-cavity die for the same detail.

From this it is possible to deduct that die and process systems, that can offer injection moulding of several details, each one having different weight, size and shape, simultaneously in one and the same process cycle, should be economically favourable, under presumption that said system has a reasonable initial cost in relation to the

overall cost reduction regarding process and die costs, that can be achieved in comparison with production of the same details with conventional 1- or multiple cavity dies.

Such die or process systems can be provided with different degrees of individual adjustment possibilities for the process parameters in the different cavities. The most simple design has only two possibilities for adjustment of the melt flow to the different cavities, with variable or fixed adjustment means. Hereby it is possible to produce several different plastic details with smaller differences in weight, size and shape in the same die system. By further providing a closing/opening valve, e.g. a valve known as a needle valve in the flow channel for each cavity, it is also possible to use different filling times for the different cavities. Plastic details having rather big mutual differences in weight, size and shape then can be produced in such a system. The pressure development for the melt during the compression and post pressure phases, which is essential for the quality of the plastic detail, however can not be chosen individually for each cavity in this system, which is an essential limitation if there is a demand that the different plastic details produced shall have a high and equivalent quality.

The invention hereinafter described offers a flexible die system and method, by means of which details of completely different weight, size and shape, can be injection moulded in injection moulding machines of standard design for thermoplastics and thermoplastic elastomers, in one and the same process cycle. For each cavity of the die units, which form part of the system, the process parameters can be individually chosen to a very high degree, primarily what concerns the pressure development during the compression and post pressure phases and the post pressure time, whereby all plastic details will get a high and equivalent quality.

The only hitherto known alternative for obtaining a similar high degree of individually electable process parameters for the different cavities/die units, is using an injection moulding machine provided with several separate injection units, which are each connected to the different die units of the system. The initial cost for such a machine

however is high, whereby it might be difficult to achieve a good economy with such a system.

The present invention refers to a system and a method for use in injection moulding machines of standard design for thermoplastics and thermoplastic . in order simultaneously to injection mould details with different weight, shape and size in a system with different die units for these details.

The purpose of the invention is to give to the different die units a possibility of a very high degree of individual choice of the process parameters which are deciding for the quality of the plastic detail moulded in the die unit.
These parameters are

- melt flow (injection moulding speed) as a function of time,
- pressure development in the melt during compression and post pressure phases,
- post pressure time,
- melt temperature,
- die temperature,

wherein the two last mentioned parameters can be varied within the intervals recommended for the plastic material concerned.

Common parameters for die units and processes are

- mould clamping force,
- process cycle time.

This purpose has been achieved at a system for injection moulding of thermoplastics and thermoplastic elastomers in an injection moulding machine in order simultaneously to injection mould details with different weight, shape and size, and incorporating a feeder block, a number of hot moulding modules each connected to one of a number of flow channels provided in the feeder block, a torpedo provided in the flow channel or in the hot moulding module, respectively for individual and infinite adjustment of the melt flow through the module, and means for bringing about final

filling, compression of the melt and changing-over to and maintaining of post pressure, and a control unit, which in dependency of a starting signal from a control device forming part of the injection moulding machine, for each hot moulding module exerts individual control and supervision of the developments in the different hot moulding modules, by the features defined in the characterizing part of claim 1.

Hereinafter the invention will be further described with reference to embodiments shown in the accompanying drawings, which show details from two different variants of an injection moulding machine incorporating the system according to the invention.

Fig. 1 shows a partial section through a portion of a hot moulding module according to a first embodiment of the invention.

Fig. 2 shows a partial section through a second embodiment of a hot moulding module according to the invention.

Fig. 3 is a view, partly in cross section of the hot moulding module shown in Fig. 2 and seen straight from above according to Fig. 2.

Fig. 4 is a view as seen from the parting plane of the mould, showing hot moulding modules, with a portion of a driving device mounted in a system for two mould units.

Fig. 5 is a side view wherein are shown the feeder block, the hot moulding nozzles for the mould units and the fixed splits of one of the mould units.

The main components of the system, which are shown in Fig. 1 and 2 and are made in accordance with the invention, are a feeder block 1, and a plurality of hot moulding modules 4 or 5 connected thereto. The feeder block has channels 2, which distribute the melt flow in Fig. 1 and 2 respectively, from the injection unit 3 of the machine into several separate flows of melt to each one of the associated hot moulding modules, of which the cylinders 4 and 5 of one each are shown in the figures.

A driving device 6, partly shown in Fig. 2 and 4, is connected to the hot moulding module, and which imparts motion and force to mechanisms built into the hot moulding module for causing in the associated die unit 21 in Fig. 5 an individual filling, compression and post pressure function to the melt which shall form a plastic detail in the cavity of the mould unit. Furthermore there is a not further shown control unit for individual control and supervision of the above mentioned injection moulding process in the different hot moulding modules/die units. The flow resistance for the flow of melt in the hot moulding module can be varied by manual adjustment of a mechanism, such as will be described in the following. The flow channel of the hot moulding module communicates with the flow channels and the cavities of the associated mould unit via a hot runner nozzle 22 in Fig. 5, which is fitted to the cylinder of the hot moulding module, or via a not shown cold moulding bushing, which is arranged in the die unit. The die units are mounted in the moulding system with easily detachable attachment means 23 (Fig. 4 and 5), which gives rapid change-over between different plastic details during progressive production.

The feeder block 1 in Fig. 2 and 5 is heated to the temperature of the melt and is positioned in the centre hole of the machine platen, but with an intermediate air slot, thus that it is insulated from the platen. The cylinders 4 and 5 of the hot moulding module are also heated to the temperature of the melt and are insulated by means of air slots 24 in Fig. 4 and 5 from surrounding support plates 25 and 26 in Fig. 5. In cylinder 4 in Fig. 1, there is a hollow through channel 7, which is partly filled out by a torpedo 9, which is infinitely axially adjustable against a seat 8 in the cylinder, thus that the distance between its tapering head and the seat 8 in the cylinder can be adjusted in order thereby to set the flow resistance for the melt through the cylinder. The embodiment according to Fig. 2 has the corresponding function for setting the flow resistance in the smaller cylinder, which is situated closest to the feeder block 1. The axial motion of the torpedo 9 is obtained by means of a displacement mechanism, e.g. such as shown a screw mechanism 10. The current position and the axial displacement of the torpedo can be red on a scale 12 (Fig. 1 and 2). For each mould unit an axial adjustment position has been established for the torpedo, i.e. a value on the scale, which gives a melt flow adapted thus that an appropriate filling time is obtained for the cavity. This

adjustment of the torpedo, specific to each die unit shall always be used, independent of the combination of other die units, which the said die unit is processed together with. The flow channel 2 from the feeder block 1 in Fig. 1, opens in an annular channel 13 arranged at the biggest diameter of the tapering head of the torpedo. This annular channel, like the other flow channels are correctly designed from a flow technical point of view, whereby the plastic melt will not be stationary at any position and thereby become thermally degraded, resulting in a poor plastic detail quality.

The torpedo 9 according to Fig. 1 is provided with a hole extending straight through its centre, and through which extends a bar 14, which at one of its ends is equipped with a tip 15 and a stop ring 16 of the same type as at a usual plasticizing screw for injection moulding machines. Thereby this stop ring can act as a ram in the space 17 located in front of the tip 15, i.e. the stroke volume of the ram. The opposite end of the bar is situated outside the torpedo and is connected to an only partly shown driving device 6 in Fig. 2 and 4, e.g. an electrical servo motor coupled to a roller screw, which provides motion and force in axial direction to the bar. In the figures the ram 15 and 16 is in its initial position, whereby filling of the cavity can be accomplished directly from the injection unit of the machine. In order to get the lowest possible flow resistance for the flow of melt, the block has three uniformly distributed flow channels, at tip and stop ring, with intermediate supporting surfaces for the stop ring. The cylindrical space 17 corresponds to 10-20% of the maximum volume of plastic material, which the system can fill into each die unit.

In the outlet 18 from the hot moulding modules 4 (Fig. 1) and 5 (Fig. 2) of the mould unit it is possible to arrange a pressure sensor 19, (Fig. 4) for measuring the pressure of the melt and this sensor is connected to the control unit, for supervision of the melt pressure development during the filling phase, the change-over point and the post pressure phase.

Each hot moulding module also has separate contact means 20, in Fig. 4 and 5, for cabling to heating elements and thermo sensors provided in the cylinders 4 and 5 and in the feeder block 1.

The function development for a complete process cycle of the system according to the invention will be described hereinafter.

The ram mechanism in the hot moulding module can be given two alternative function developments.

In the first alternative, when it is assumed that the weight of the plastic melt, which is accommodated within the stroke volume 17 is bigger than the total weight of detail(s) and cold moulding channel(s) in the associated die unit, the ram can start at the same time as the screw piston of the injection unit of the machine and thereby itself provide for the entire filling phase and compression and post pressure phases in the process cycle for the associated die unit.

At the second alternative, when the weight of the plastic melt accommodated within the stroke volume 17 is supposed to be lower than the total weight of detail(s) and cold moulding channel(s) the filling of the die unit must be partly effected by the injection unit of the machine, whereupon final filling, compression and post pressure phases are carried out by the ram 15, 16 in the hot moulding module.

The flow resistances in each hot moulding module with a function according to the second alternative are set to values, which have been established at outcome test runs for every die unit.

The flow resistance in each hot moulding module with a function according to the first alternative is on the other hand set to the lowest value.

The characterizing function for the system according to the invention of the second alternative, that the ram mechanism in each hot moulding module, due to its individually controllable motion and force creating function, can take over the filling function at any optional time during the filling of the mould unit executed by the injection unit, and finish filling, compression and change-over to and accomplish the post pressure phase, is obtained in that the screw piston of the injection unit of the machine during its advance movement reaches several different sensor positions, one

for each hot moulding module, set to function according to the second alternative, whereby each one of the sensors give a signal to the control unit of the injection unit to lower the injection speed, i.e. the flow of melt, with a value which is usually equal to the melt flow which flows through the receiving hot mould module at this time. In parallel with the above said sensor system belonging to the machine, there is provided another sensor system belonging to the system according to the invention, wherein the sensors are also actuated when the screw piston of the machine injection unit reaches their different positions, but wherein the signal from the different sensors is utilized for starting the driving device for the ram mechanism in each hot moulding module. These sensors, arranged in pairs, one from each system, with reference to their positions, can be carefully adjusted relative to each other, whereby the starting time for the ram of the hot moulding module can be postponed or put earlier in relation to the time set for melt flow reduction in the injection unit of the machine. Thereby it is possible to avoid, entirely or partly, that a very acute, but process disturbing deviation in the melt pressure and flow development, a so called transient, will result at the passing over of the process from the injection unit of the machine to the ram mechanism of the hot moulding module.

An essential advantage with the system according to the invention is that the plastification for the subsequent process cycle can be started from the time when all ram mechanisms in the system have been activated. This property of the system makes it possible in certain applications to obtain a shorter process cycle time as compared to injection moulding with a moulding system, which in this respect is conventional, e.g. when the details have high weights or when using plastic material, which requires a lenient mechanical treatment by the screw piston, i.e. low rotational speed during the plastification, which results in an extended plastification time.

Another advantage of the system according to the invention is that the change-over point, i.e. where the filling phase is succeeded by a post pressure phase, by smaller amendments of the filling times for the different die units, can be placed at different times in the process cycle, whereby the melt pressure peaks, which are connected to the change-over point, will not take place at the same time. Hereby it is possible to use a

lower mould clamping force for the machine as compared to conventional multiple cavity injection moulding of the same details.

The invention is not limited to the embodiment schematically illustrated in the drawings and described in connection thereto but modifications are possible within the scope of the following claims.

CLAIMS

1. System for injection moulding of thermoplastics and thermoplastic elastomers in an injection moulding machine for injection moulding details of different weight, size and shape, simultaneously in only one process cycle, and incorporating a feeder block (1), a number of hot mould modules (4, 5), each connected to its own one of a number of flow channels (2) provided in the feeder block, a torpedo (9) provided in the flow channel for each hot moulding module and intended for stepless adjustment of the melt flow through the module, and means for causing final filling, compression and change-over to and maintaining of post pressure, and a control unit for individual control and supervision of the processes in the different hot moulding modules,
characterized therein,
that the flow channel of the hot moulding module is provided with a movable bar (14) extending axially therethrough, and which at its forward end is designed as a ram (15, 16), which is adapted to operate in a melt channel space (17) downstream of the torpedo (9) for causing final filling, compression, change-over to post pressure and maintaining this, and which bar is connected to an individual driving device arranged to give the bar axial motion and pressure force under control from the control unit.

2. System according to claim 1,
characterized therein,
that the torpedo (9) is arranged axially adjustable in the flow channel in the different hot moulding modules and is provided with an axially longitudinal through-hole (7), through which extends the axially movable bar (14), which at its end projecting from the forward part of the torpedo is designed as said ram (15, 16).

3. System according to claim 1,
characterized therein,
that the torpedo (9) is arranged in a conically shaped flow channel in a cylinder forming part of the hot moulding module (5), wherein said cylinder is arranged to connect the flow channel (2) in the feeder block (1) with a part of the hot moulding module, which incorporates said ram (15, 16).

4. System according to anyone of claims 1 to 3,
characterized therein,
that position sensors are connected to the control unit of the system, which position sensors are arranged in pairs with position sensors of the injection unit, and which are adjustable in position in relation to these and whereby this adjustability will give an entirely or partial transient free change-over when the means for speed and force generation belonging to a hot moulding module takes over the flow and pressure developments of the melt from the injection unit of the machine.

5. System according to anyone of claims 1 to 4,
characterized therein,
that the torpedo (9), in a manner known per se, has a substantially tapering end and is manually displaceable in axial direction towards and away from a tapering seat (8) for individual adjustment of the melt flow resistance in the flow channel of each hot mould module, and that the axial displacement is adjusted by means of a displacement mechanism, in the form of a screw mechanism (10), wherein a nut forming part thereof can be manually turned thus that a threaded portion of the shaft in one end of the torpedo cooperating therewith is axially displaceable and thereby also the entire torpedo (9).

6. System according to claim 5,
characterized therein,
that a scale (21) is provided for reading the current position of the torpedo and its axial displacement.

7. System according to anyone of the preceding claims,
characterized therein,
that a pressure sensor (19) connected to the control unit is arranged at the opening of each melt channel (17) downstream of the torpedo (9), or the ram (15, 16), respectively.

8. A method for injection moulding of thermoplastics and thermoplastic elastomers in an injection moulding machine for simultaneously axially displaceable moulding in the same process cycle details of different weight, size and shape in a system having different die units, by means of a device incorporating a feeder block (1), a number of hot moulding modules (4, 5), each connected to its own of a number of flow channels (2) provided in the feeder block, a torpedo (9) provided in the flow channel for each hot moulding module and intended to adjust the melt flow through the module in a stepless manner, and means for causing final filling, compression and change-over to and maintaining post pressure, and a control unit for individual control and supervision of the processes in the different hot moulding modules, with use of a system according to claim 1,

characterized therein,

that the melt flow from the feeder block is controlled in the different hot moulding modules, by means of individual setting of the axial position of the associated torpedo (9), whereby is obtained different filling times in order to distribute in time, pressure peaks in the different hot moulding modules (5, 5) and die units of the injection moulding system.

9. A method for injection moulding of thermoplastics and thermoplastic elastomers in an injection moulding machine for simultaneously moulding details of different weight, size and shape in the same process cycle, in a system having different die units, by means of a device incorporating a feeder block (1), a number of hot moulding modules (4, 5), each connected to its own of a number of flow channels (2) provided in the feeder block, a torpedo (9) provided in the flow channel for each hot moulding module and intended to adjust the melt flow through the module in a stepless manner, and means for causing final filling, compression and change-over to and maintaining of post pressure, and a control unit for individual control and supervision of the processes in the different hot moulding modules, with use of a system according to claim 1,

characterized therein,

that plastification of the material for the subsequent process cycle is started as soon as the die unit having the longest filling time is completely filled and the ram (15, 16) in the associated hot mould module has been activated, thus that the plastification for the

next process cycle takes place , at least partially, simultaneously with the post pressure phase in the current process cycle.

FIG.1

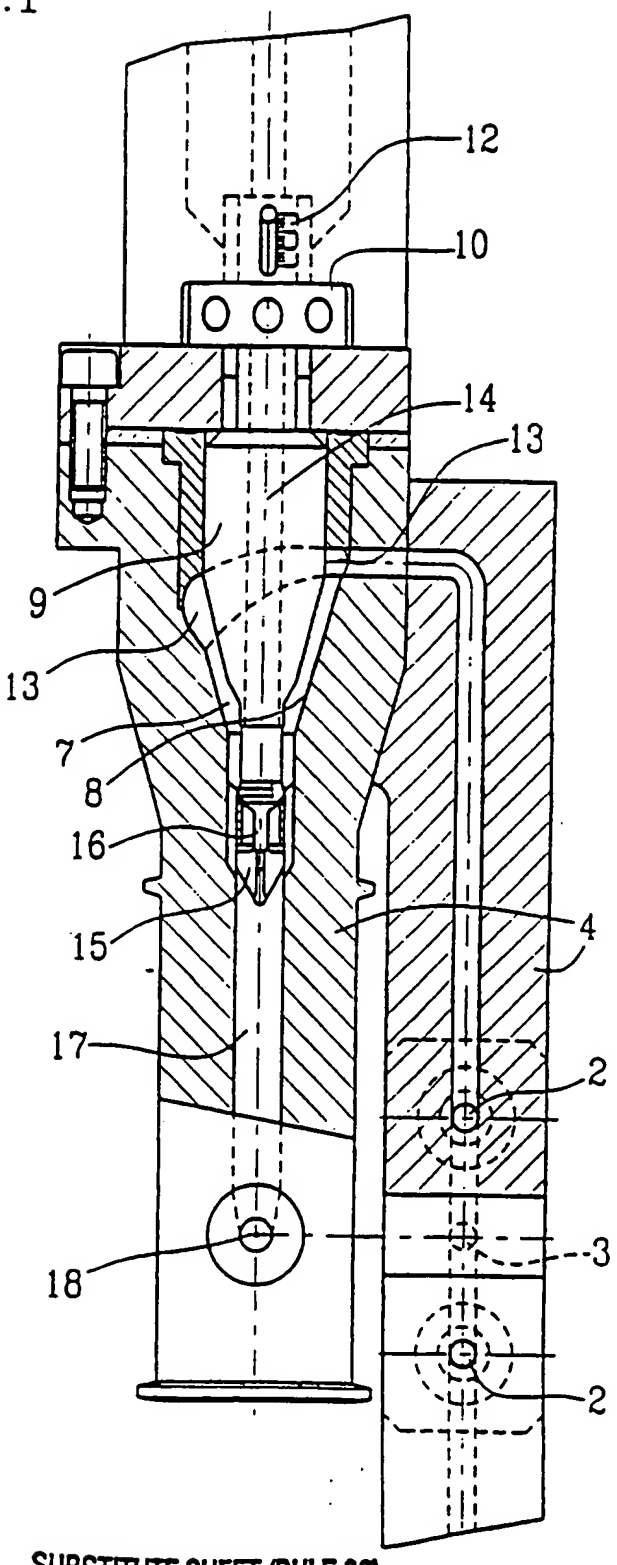


FIG.2

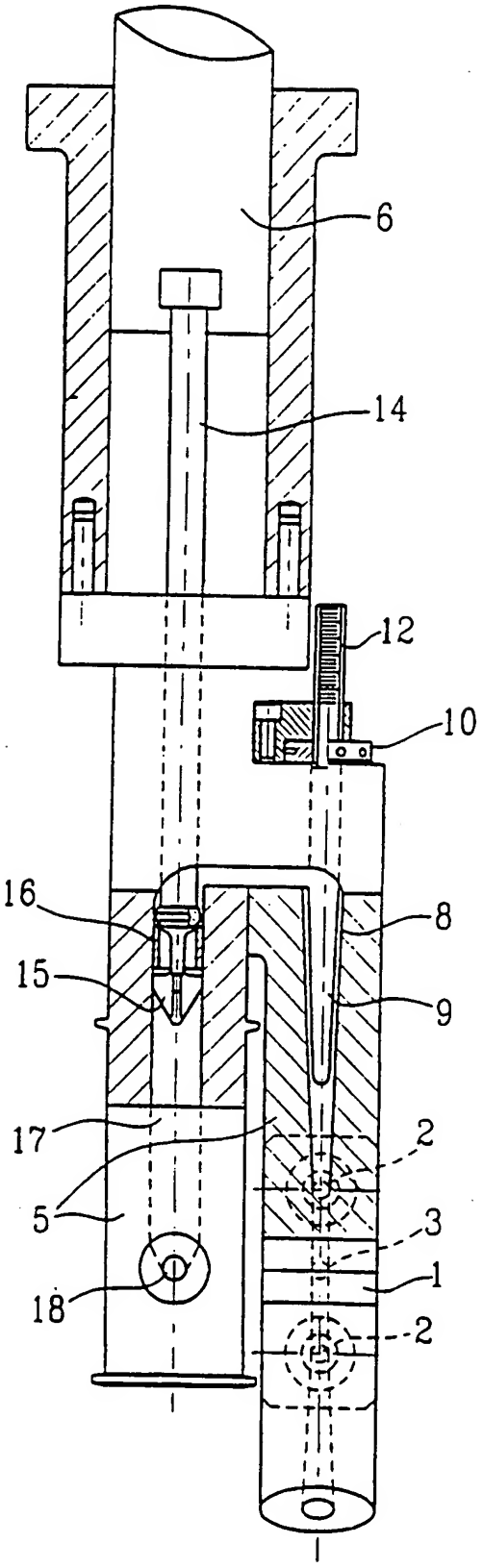
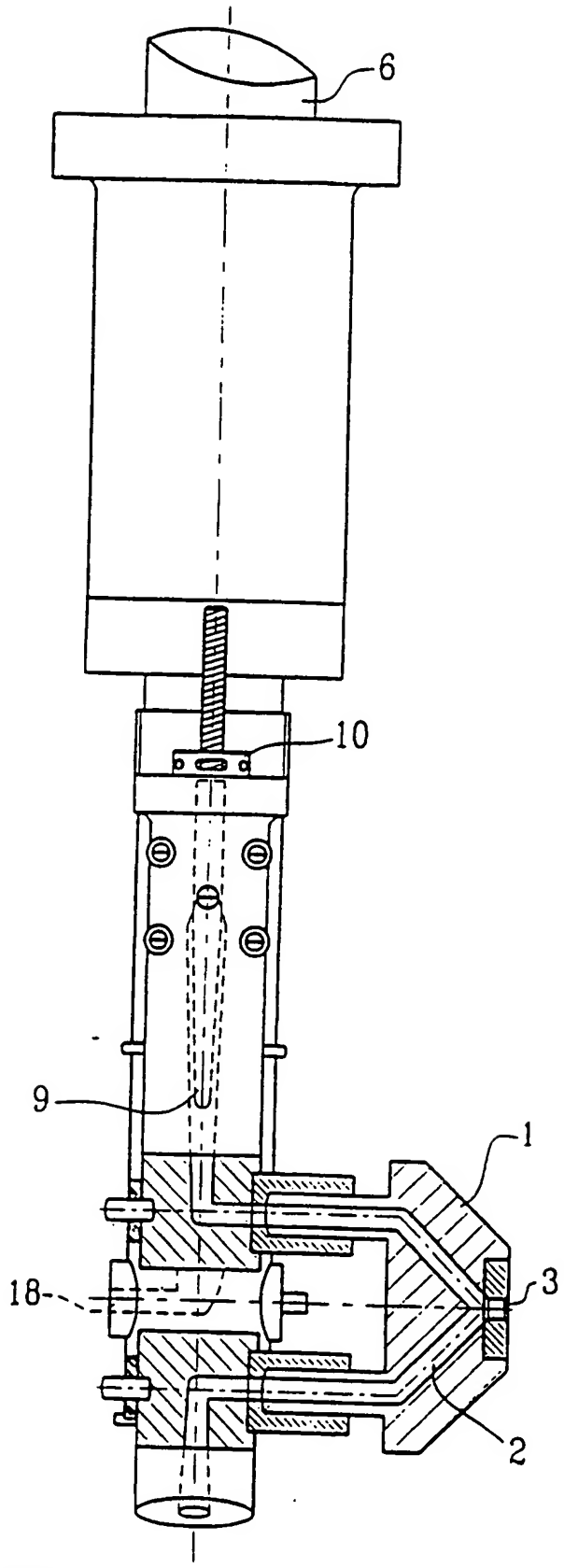


FIG.3



INTERNATIONAL SEARCH REPORT

Information on patent family members

06/08/97

International application No.
PCT/SE 97/00781

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0491332 A2	24/06/92	SE 0491332 T3	
		AT 135956 T	15/04/96
		CA 2032396 A	20/06/92
		DE 4141515 A	25/06/92
		DE 69118336 D,T	08/08/96
		ES 2084758 T	16/05/96
		JP 6023798 A	01/02/94
		US 5227181 A	13/07/93
DE 1729333 A1	06/04/72	AT 312266 A,B	15/11/73
		BE 701398 A	15/01/68
		CH 449953 A	00/00/00
		CH 461788 A	00/00/00
		FR 1543260 A	00/00/00
		GB 1158389 A	16/07/69
		NL 6709818 A	04/03/68
		SE 330969 B	07/12/70
		US 3537139 A	03/11/70
DE 2357666 A1	12/06/74	BE 807893 A	28/05/74
		FR 2209659 A,B	05/07/74
		GB 1423278 A	04/02/76
		LU 68932 A	05/07/74
		NL 7316532 A	11/06/74
EP 0229689 A2	22/07/87	AU 605126 B	10/01/91
		AU 6716687 A	09/07/87
		CA 1274959 A	09/10/90
		DE 3778167 A	21/05/92
		JP 62282913 A	08/12/87
		KR 9512860 B	23/10/95
		US 4755126 A	05/07/88
		US 4902219 A	20/02/90
		US 5085572 A	04/02/92
		US 4913912 A	03/04/90
EP 0336748 A2	11/10/89	AU 628808 B	24/09/92
		AU 3248189 A	12/10/89
		CA 1330156 A	14/06/94
		JP 2014115 A	18/01/90
		US 4913912 A	03/04/90
		US 5085572 A	04/02/92
EP 0452611 A2	23/10/91	DE 69101018 D,T	05/05/94
		JP 6166063 A	14/06/94
		US 5037598 A	06/08/91

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/00781

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B29C 45/30
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Patent Abstracts of Japan, Vol 10,No 231, M-506, abstract of JP,A,61-63428 (NIPPON DENSO CO LTD), 1 April 1986 (01.04.86) --	1-9
A	EP 0491332 A2 (MOLD-MASTERS LIMITED), 24 June 1992 (24.06.92), abstract --	1-9
A	DE 1729333 A1 (SEGMÜLLER AG), 6 April 1972 (06.04.72), abstract --	1-9
A	DE 2357666 A1 (SOCIETE FULMEN, CLICHY), 12 June 1974 (12.06.74), abstract --	1-9

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 Sept 1997	15 -09- 1997
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Tommy Vikholm Telephone N . +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/00781

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0229689 A2 (FAST HEAT ELEMENT), 22 July 1987 (22.07.87), abstract ---	1-9
A	EP 0336748 A2 (FAST HEAT ELEMENT), 11 October 1989 (11.10.89), abstract ---	1-9
A	EP 0452611 A2 (HUSKY INJECTION MOLDING SYSTEMS LTD.), 23 October 1991 (23.10.91), abstract ---	1-9

FIG.4

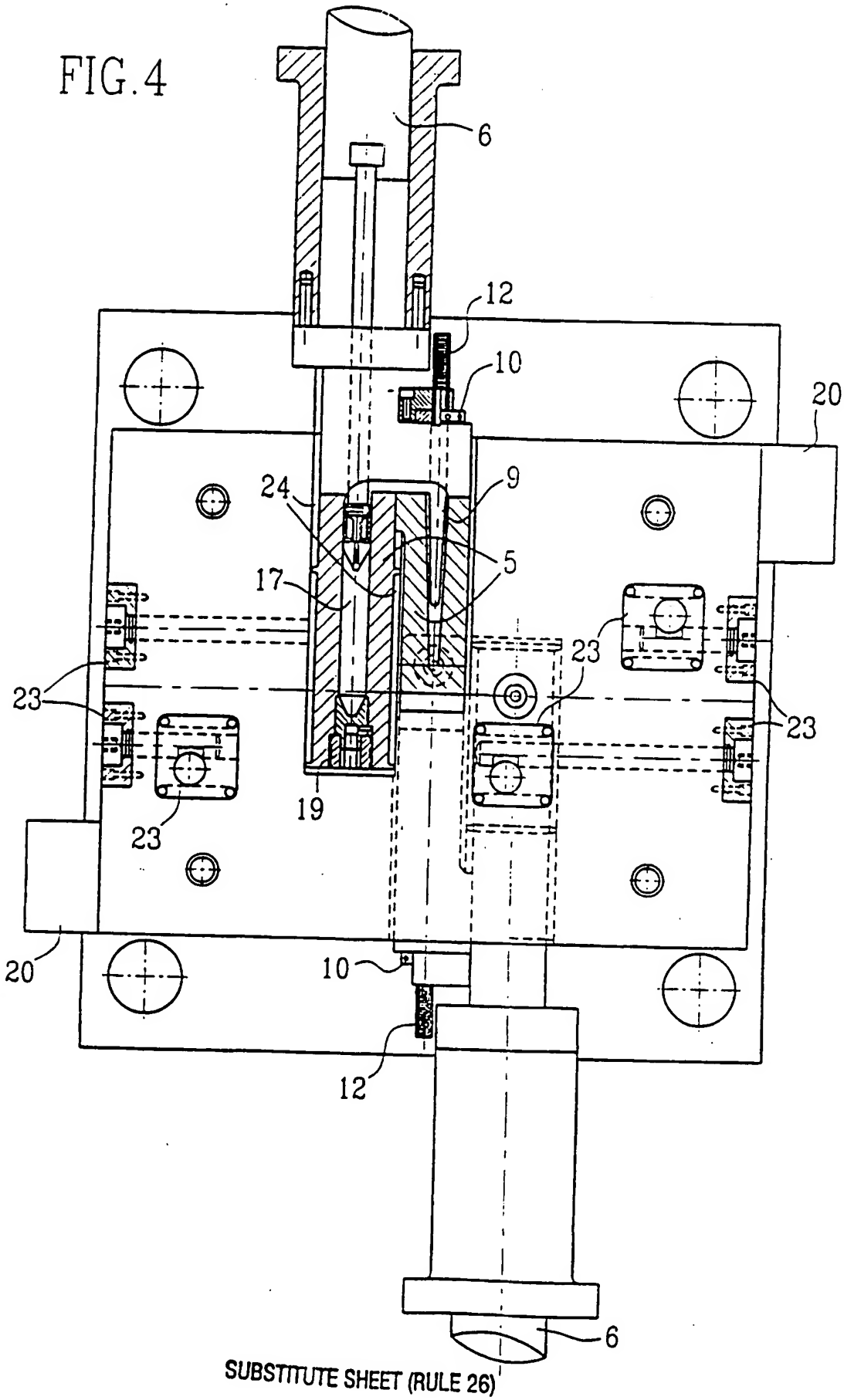


FIG.5